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Course: INF2178 Experimental Design for Data Science
Assignment: Technical Assignment 4

Exploring MRI results of patients with/without dementia

1. Introduction

Data from a longitudinal study on MRI results of patients with/without dementia will be used, the dataset will be used to evaluate the eTIV and nWBV difference between patients within multiple visits for MRI results.

Research Questions:

Research Question 1: How does eTIV (Estimated Total Intracranial Volume) vary between different patients within multiple visits, is the difference significant?

Research Question 2: How does nWBV (Normalize Whole Brain Volume) vary between different patients within multiple visits, is the difference significant?

2. Data Cleaning and Data Wrangling

The dataset comprises 15 columns and 294 rows since we are only interested in demented/undemented patient we removed the 'Converted' category resulting in 268 rows left.

Interested Columns:

Group: Representing the type of the subject

Visit: Representing which visit the result corresponds to for each patients

eTIV: Estimated Total Intracranial

nWBV: Normalize Whole Brain Volume

3. Exploratory Data Analysis (EDA)

Categorical Variables:

There are two categorical variables we are interested in, 'Group' contains demented and Nondemented type and Visit consists only of Visit 1 and Visit 2.

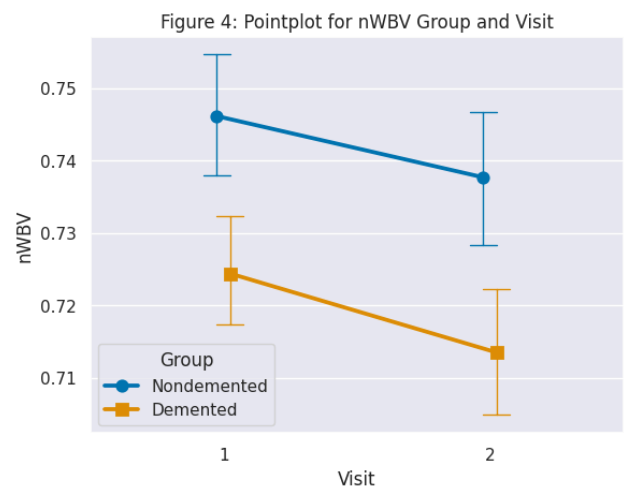
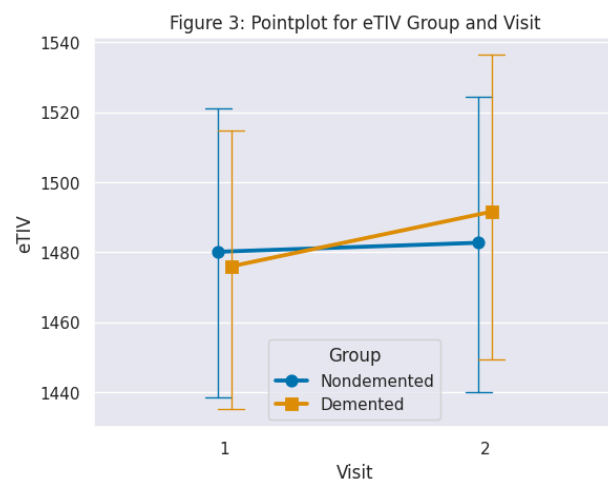
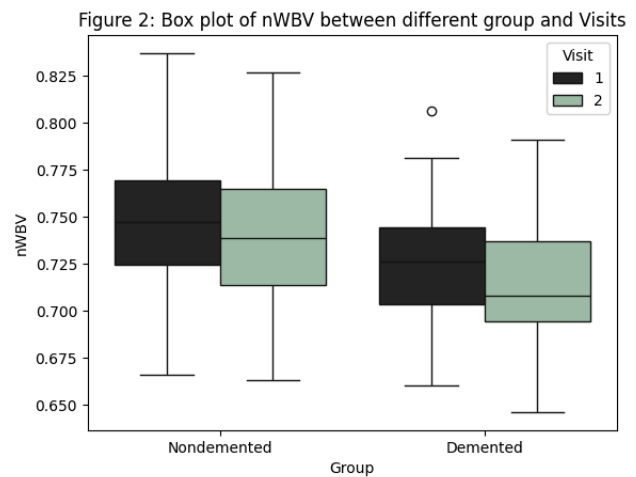
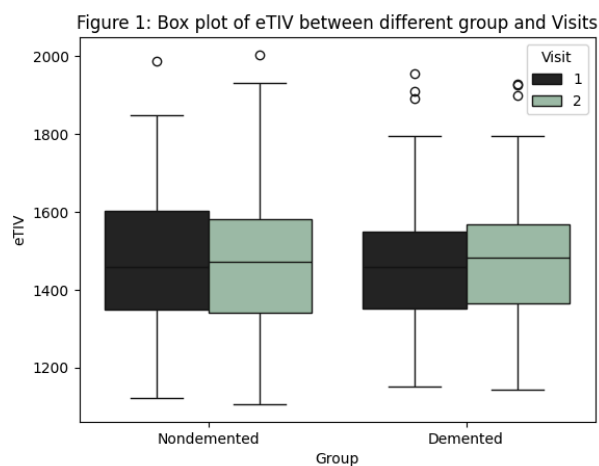
Continuous Variables:

Table 1:

index	eTIV	nWBV
count	268.0	268.0
mean	1482.4328358208954	0.731179104477612
std	179.64121328228384	0.0377271598183468

min	1106.0	0.646
25%	1351.0	0.7024999999999999
50%	1465.5	0.733
75%	1569.0	0.756
max	2004.0	0.837

Referencing Table 1, looking at the values we see that nWBV is a positive number below 1 and eTIV's value will vary by a lot compared to nWBV.



By examining Figure 1 we can see that the difference between different combinations of Group, Visit does not differ a lot for eTIV with (Nondemented, 1), (Demented, 1) showing the biggest difference. On the other side looking at Figure 2 we can see that nWBV seems to show a significant difference between Nondemented and Demented Group. Examining the point plot in the bottom we see that it better expresses the change between two visits. Looking at Figure 3, for eTIV it seems like the eTIV increased for both groups with demented group having a higher increase. Looking at figure 4, for nWBV the two lines seem parallel, hinting that both groups have the same amount of change between two visits, might be

an indication of Group not affecting Visit for nWBV. We can take note of these findings for our ANOVA model.

4. Mixed ANOVA

Below we will be conducting Mixed ANOVA for eTIV between Subjects and within Visits.

Table 2:

Source	SS	DF1	DF2	MS	F	p-unc	np2	eps
Group	1615.428	1	130	1615.428	0.025	0.875	0.000	nan
Visit	5158.670	1	130	5158.670	7.938	0.006	0.058	1.000
Interaction	1003.366	1	130	1003.366	1.544	0.216	0.012	nan

From Table 2 we see that the main effect of 'Group' is not significant with $p > 0.05$. This suggests that there is no significant difference in eTIV between demented and non demented patients. 'Visit' is significant with $p < 0.05$, this indicates a significant difference in the dependent variable across different visits. The interaction between group and visit is not significant, this suggests that the effect of visit on eTIV does not differ significantly between groups.

Assumption check:

Mauchly's test of sphericity:

P-value = 1.0, $p > 0.05$ indicates no violation of sphericity.

Test of Normality:

Table 3:

Visit	W	pval	normal
1	0.9700769186019897	0.004334521014243364	false
2	0.9769943952560425	0.0243346206843853	false

Null hypothesis of normality is rejected for both Visits. Pval < 0.05 .

Test of Homogeneity:

Table 4:

index	W	pval	equal_var
levene	0.05505777890566267	0.8146656174208813	true

Pval > 0.05 , indicating no violation of homogeneity of Variances.

Next we will look at Mixed ANOVA for nWBV

Table 5:

Source	SS	DF1	DF2	MS	F	p-unc	np2	eps
Group	0.033	1	130	0.033	13.312	0.000	0.093	nan
Visit	0.006	1	130	0.006	81.617	0.000	0.386	1.000

Interaction 0.000 1 130 0.000 2.524 0.115 0.019 nan

Group and Visit both have $p < 0.05$ suggesting a significant difference in nWBV across different Group or Visits. But the Interaction of Group and Visit has a $p > 0.05$ indicating the effect of Visit on nWBV does not differ significantly between demented/nondemented patients.

Assumption check:

Mauchly's test of sphericity:

P-value = 1.0, $p > 0.05$ indicates no violation of sphericity.

Test of Normality:

Visit	W	pval	normal
1	0.9897395968437195	0.41652101278305054	true
2	0.9890501499176025	0.3822091519832611	true

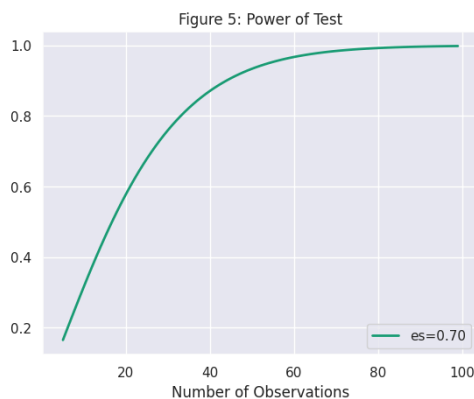
No violation of normality for both Visit since $p > 0.05$

Test of Homogeneity:

index	W	pval	equal_var
levene	0.4442187593353281	0.5056708933760736	true

No violation of Homogeneity since $p > 0.05$

5. Power Analysis



The sample size for an effect size of 0.7, power of 0.91, alpha of 0.05 is **46**. The result can be further supported by the plot shown in Figure 5. When power reaches 0.91 its approximately 46.

6. Conclusion

In this report, we analyzed the MRI result dataset to explore whether there is difference in MRI results for Demented/Nondemented patients within their two visits. We addressed two research question:

1. eTIV: A mixed ANOVA revealed significant differences between Visits but no significant difference when interacting. Only normality assumption is violated
2. nWBV: A mixed ANOVA revealed significant difference between Visits and Group but no significant difference when interacting. All assumption holds

For research question 2, we can say that the result is significant since all assumptions are passed.